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Lessons in Projection.

By ROBERT RIDDELL, TEACHER OF THE ARTISAN CLASS IN THE HIGH SCHOOL, PHILADELPHIA.

Plate 70.

ON the problem shown in this plate rests the true theory of hand-railing, and the student should thoroughly master it in every particular. The correctness of the method shown for obtaining the ellipse N may be proved by cutting the lines XXXX through the paper, and then folding over the lines OOOO, and then raising the cut parts until S A stands perpendicular over the plan D. The curve N will then stand directly over the quarter circle on the plan. The methods of finding the long and short diameters, and the foci of the ellipse, have been explained in previous issues of the WOOD-WORKER. Pins are placed in the foci in order that the ellipse may be described by the aid of a thread or fine string; this process will be readily understood by referring to Fig. 1, Plate 22, March number.

We would advise the student to copy this plate entire two or three times, or until the principle involved is thoroughly understood, and the knowledge gained will doubly repay the trouble.

The Sectorian System of Hand-Railing.

NINTH PAPER.

Plate 66.

THIS plate exhibits a full circle stairs; and the well-hole enclosed with tangents, either for quadrant or octagon angles, by which wreaths in either four or eight pieces can be obtained. Where all the divisions are made equal, the same moulds, both face and falling, will answer for any section of rail. The moulds are applied, and all the twists and ramps obtained, as laid down in preceding examples. The framing is as easily put up in this example as the one shown in former plates, and is the most economical of any I have ever used in my practice, and equally as substantial.

Fig. 1 shows the ground plan, and had best be laid down on the floor where required to be built.

Fig. 2 is the stretch-out of the wreath piece for one fourth of the circle, and is best

where it is the desire to avoid many joints, though I do not see the same objection to joints that many do, when properly made. I would prefer a joint to a cross-grained piece in a wreath always.

Fig. 3 is the quarter-wreath piece, obtained in the usual way, with its tangents and chord line, segment, etc.

Fig. 4 is the lower wreath face mould, with the tangents as obtained from A, B, C, Fig. 1, and drawn as shown on this figure. The lower end of Fig. 2 gives an idea of the falling ease, and is the shape of the centre falling mould, the convex and concave falling moulds being obtained as in former examples.

Practical Carpentry.

HIP-ROOFS.

IN its most simple form the *hip-roof* is a quadrilateral pyramid, each triangular side of which is a *hip*, and the rafter in each angle is a *hip-rafter*. The *common rafters* which lie between the hip-rafters in the planes of the sides of the roof, and which, by abutting on the hip-rafters, are necessarily shorter than the length of the sloping side, are called *jack-rafters*.

The things required to be determined in a hip-roof are these, viz. :

1. The angle which a common rafter makes with the plane of the wall-head—that is, the angle of the slope of the roof.
2. The angle which the hip-rafters make with the wall head.
3. The angles which the hip-rafters make with the adjoining planes of the roofs. This is called the backing of the hip.
4. The height of the roof.
5. The lengths of the common rafters.
6. The lengths of the hip-rafters.
7. The length of the wall-plate contained between the hip-rafter and next adjacent entire common rafter.

The first, fourth, fifth, and seventh of these are generally given, and then all the others can be found from them by construction, as is about to be shown.

The plan of a building and the pitch of the roof being given, to find the lengths of the rafters, the backing of the hips, and the shoulders of the jack rafters and purlins :

PLATE 69.—Let A B C D (Fig. 1) be the plan of the roof. Draw G H parallel to the sides A D, B C, and in the middle of the distance between them. From the points A B C D, with any radius, describe the curves *a b*, *a b*, cutting the sides of the plan in *a b*. From these points, with any radius, bisect the four angles of the plan in *r r r r*, and from A B C D, through the points *r r r r*, draw the lines of the hip-rafters A G, B G, C H, D H, cutting the ridge line G H in G

PLATE 70

